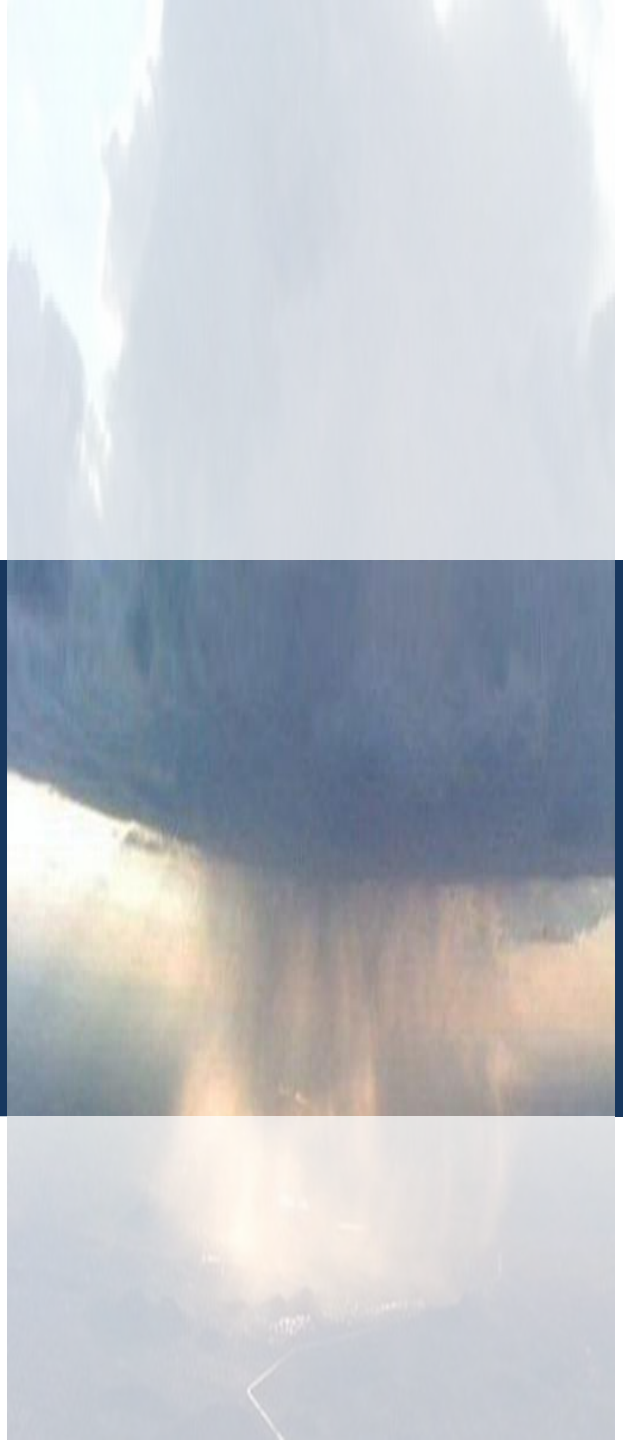

Improving early drought detection using satellite-based relative humidity data

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AIRS science meeting, 2015

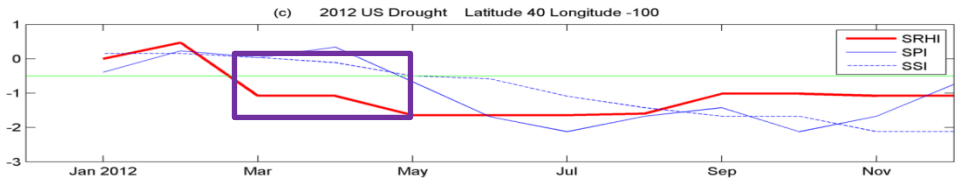
Drought early detection

- Droughts result in millions of dollars of losses every year
- Early drought detection is important:

Farmers

Water Management

- Standardized Precipitation Index (SPI) is the most commonly used index for drought onset detection.



Relative humidity and hypothesis

Hypothesis:

- Air relative humidity can detect drought onset earlier than precipitation

Relative humidity= Air vapor pressure / Saturated Vapor Pressure

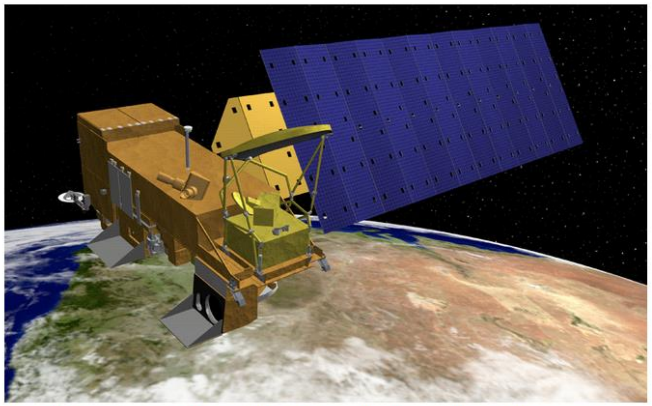
- Precipitation is not expected at low relative humidity

- Hypothesis will be validated against SPI and SSI (Standardized Soil moisture Index)

Data Sources

- Relative Humidity (AIRS Version 6 Level 3):

✓ Satellite-based Relative Humidity
✓ Atmospheric Infrared Sounder (AIRS)
Advanced Microwave Sounding Unit (AMSU)
✓ Spatial Resolution: 1 °
✓ Length: September 2002-Now



Artist rendering of the Aqua satellite, part of NASA's Earth Observing System. Credit: NASA

- Precipitation and soil moisture (MERRA reanalysis)

✓ Spatial resolution: 2/3° × 1/2°
✓ Length: January 1980-Now

Methodology

Month	RH
1	A1
2	A2
3	A3
4	A4
5	A5
6	A6
7	A7

3-Month	RH
1	A1+A2+A3
2	A2+A3+A4
3	A3+A4+A5
4	A4+A5+A6
5	A5+A6+A7

The empirical gringorton probability

$$p(RH_i) = \frac{i-0.44}{n+0.12}$$

i Rank of non zero relative humidity from the smallest

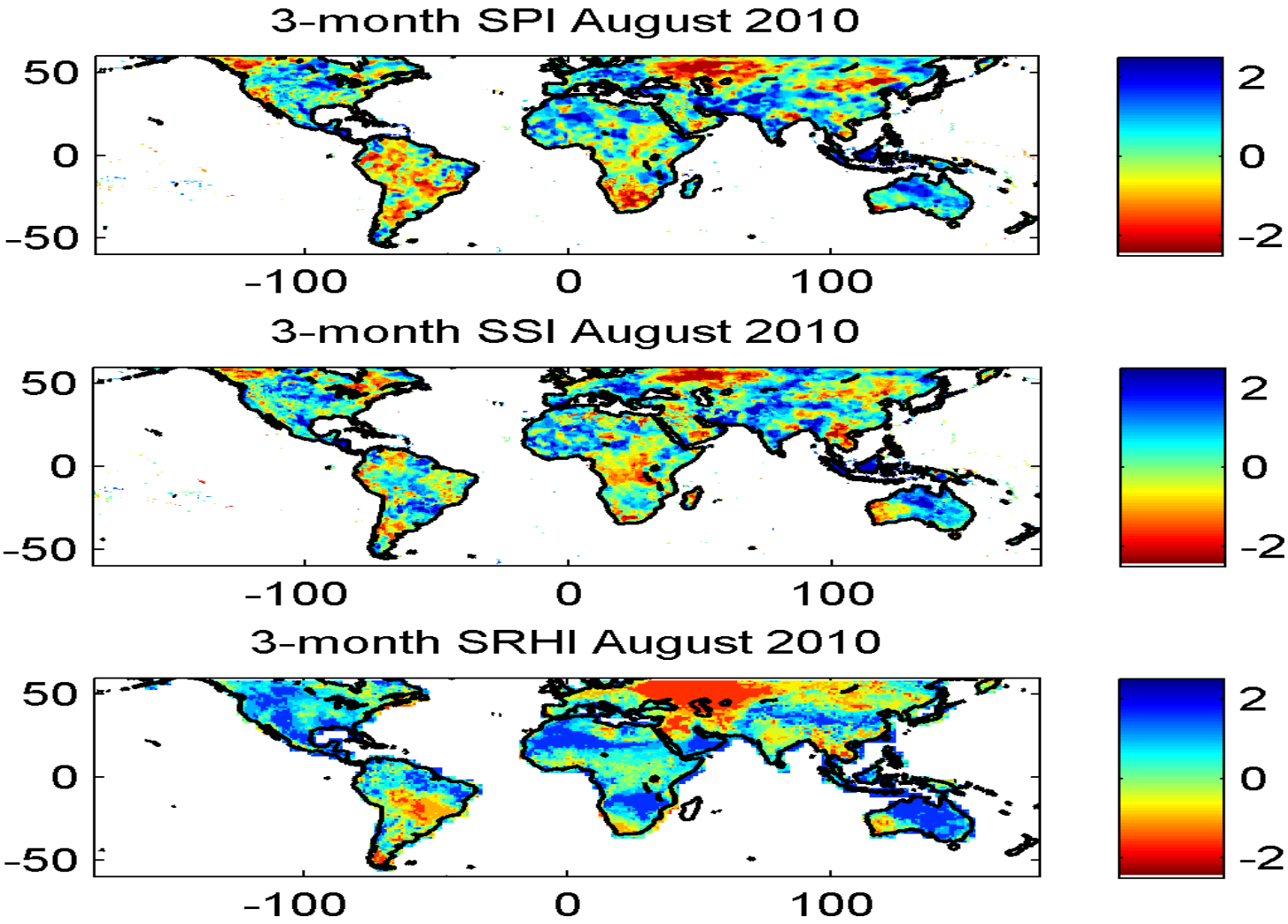
n Sample size

$$SRHI = \Phi^{-1}(p(RH_i))$$

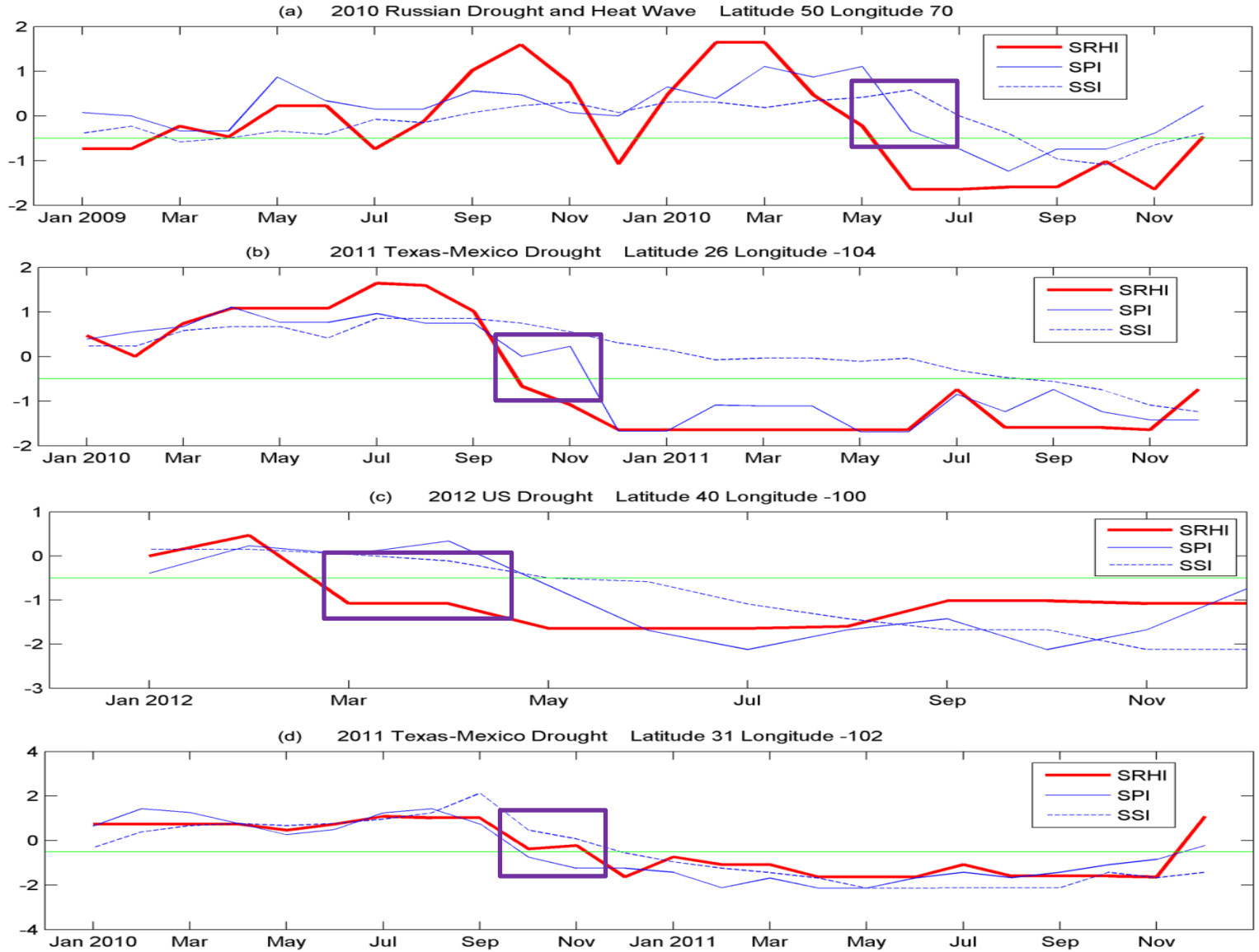
Φ Standardized normal distribution function

Citation: Farahmand, A. , AghaKouchak, A (2014), A Generalized Framework for deriving Nonparametric Standardized Drought Indicators , Advances in Water Resources

SPI,SSI and SRHI comparison



SPI,SSI and SRHI comparison



Statistical Analysis (month by month)

SPI

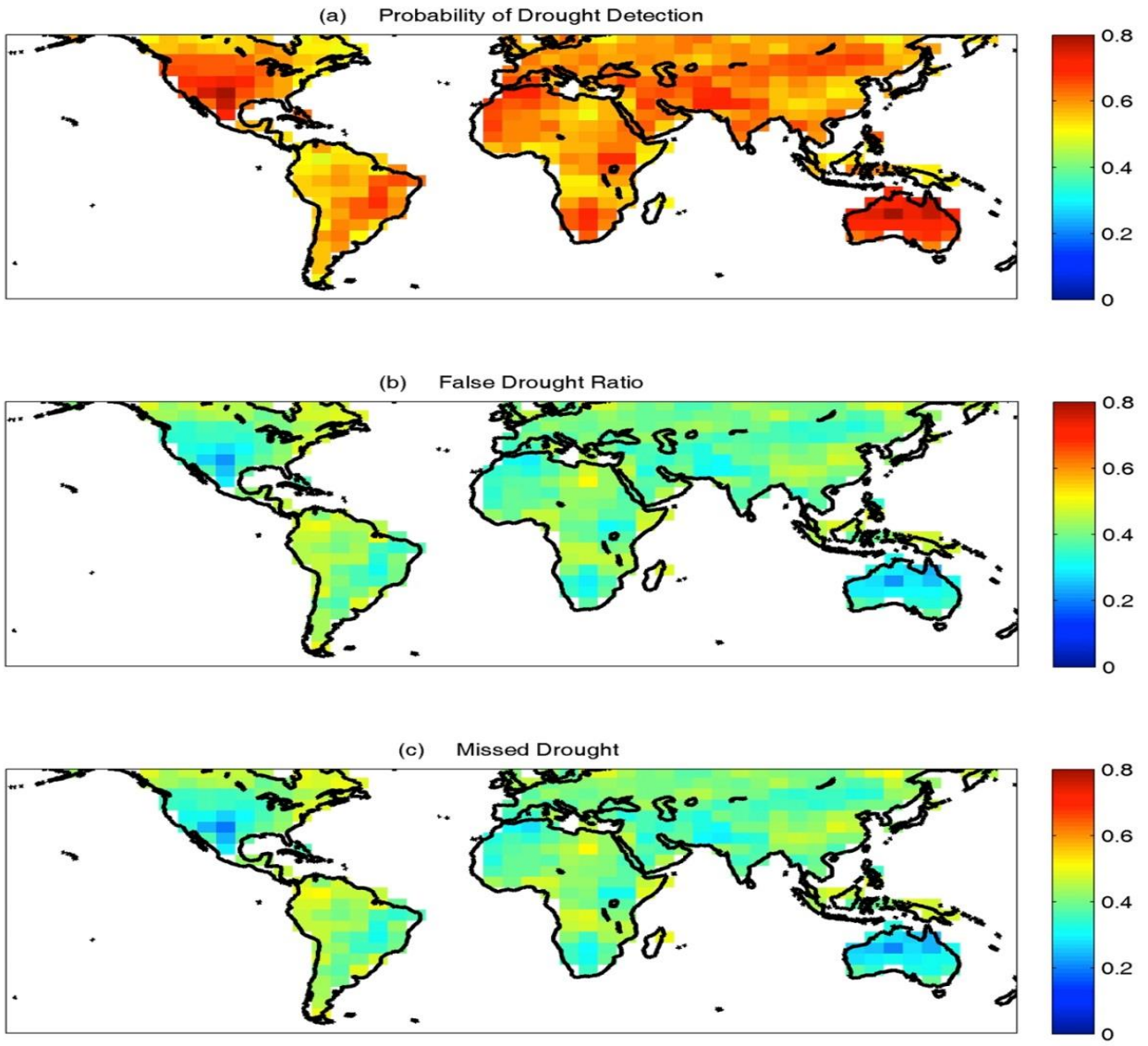
SRHI

Event Occurred? Simulations		Event Occurred? Reference Observations: Yes	Reference Observations: No
Yes		Hit (*H*)	False (*F*)
No		Miss (*M*)	True Null Event (*Q*)

a) $\frac{H}{H+M}$

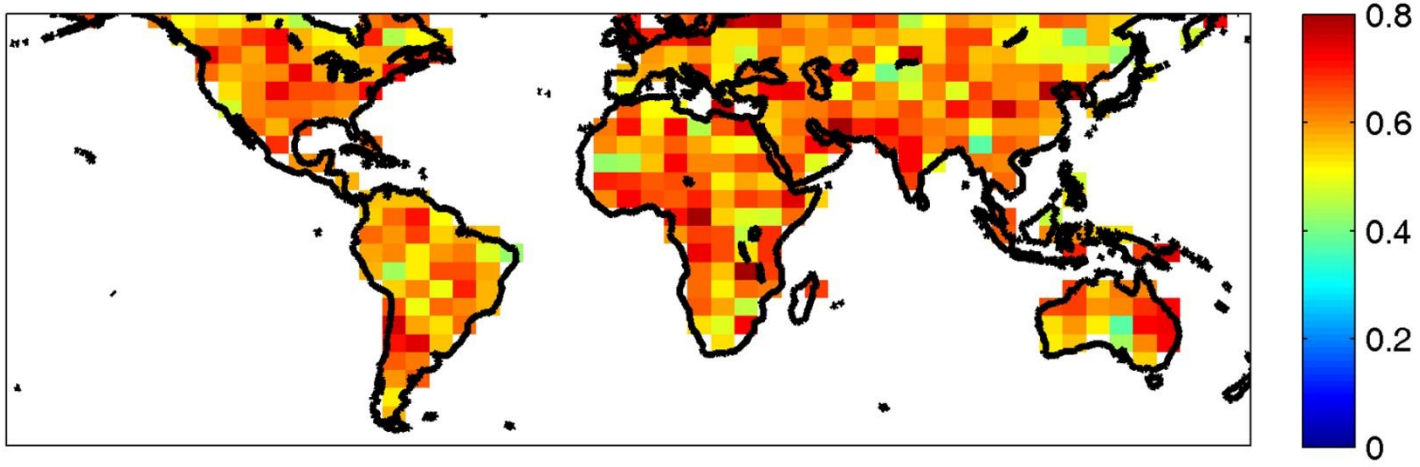
b) $\frac{F}{H+F}$

c) $\frac{M}{H+M}$

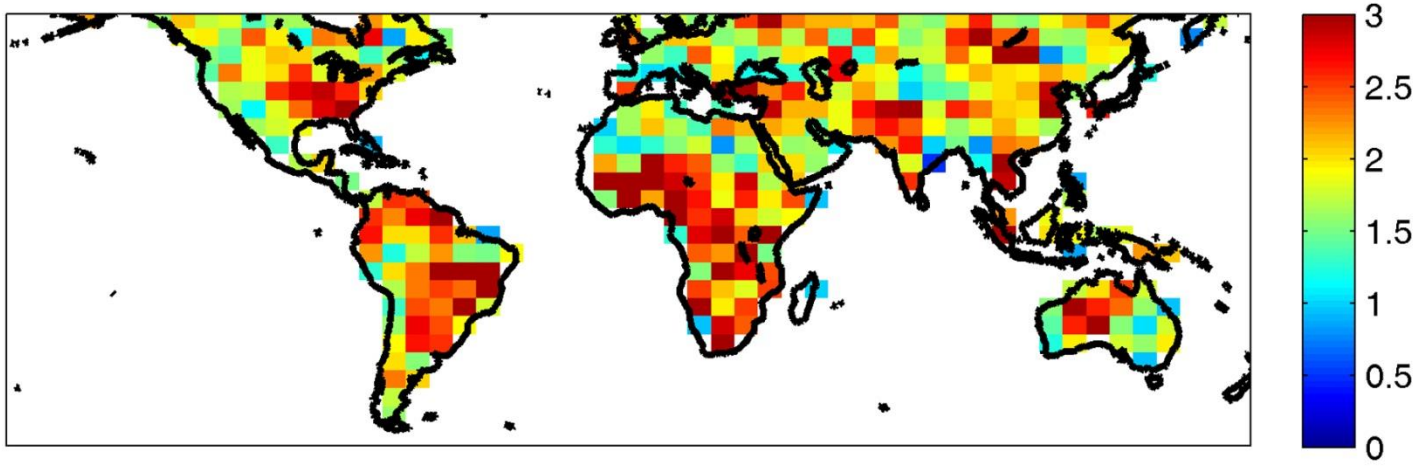


SPI and SRHI show drought for 3 consecutive months

(a) $POD_{SRHI} \mid DO_{SRHI} \leq DO_{SPI}$

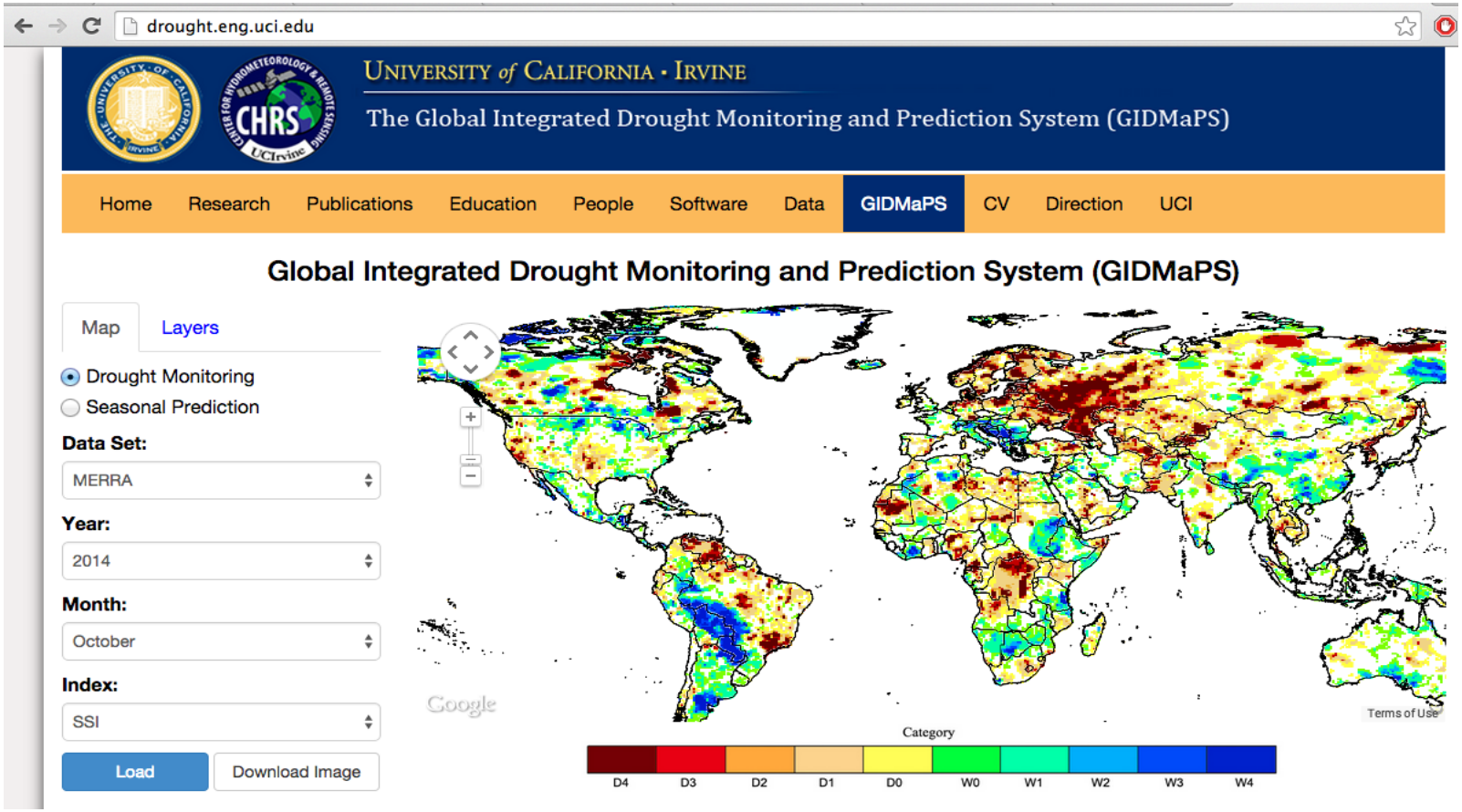


(b) Mean Lead Time of SRHI Relative to SPI (months)



Integration with global drought models

SRHI an be integrated into current global drought monitoring and predictions systems such as GIDMaPS



Conclusion & Future Work

- SRHI can potentially be used for drought early detection.
- Drought early detection is important in agriculture and water resource management
- The length of AIRS data is relatively short. Mathematical algorithms (e.g. Bayesian) can be used to create a long-term climate record.
- Relative Humidity can be combined with other variables such as soil moisture and temperature for improving drought monitoring.

Thanks!